



# ARTIFICIAL INTELLIGENCE AND INSURANCE MARKET DEVELOPMENT

Inaugural Lecture

Prof Athenia Bongani Sibindi

Department of Finance, Risk Management and Banking

8 September 2023

# OUTLINE OF THE LECTURE

Introduction

Insurance Market Development

Artificial Intelligence

Applications of Artificial Intelligence in Insurance

Emerging Themes in Artificial Intelligence and Insurance

Towards Paradigm Shifts in Insurance

Conclusion

# INTRODUCTION



The insurance industry is the backbone of many economies due to its role in intermediation, investment, employment creation and risk bearing functions amongst others.



As such, due to the importance of the insurance industry in the economic growth and economic well-being of economies extant studies have been conducted on the factors that spur insurance market development (see for instance: Kiwanuka & Sibindi, 2023; Segodi & Sibindi, 2022; Flores, de Carvalho & Sampaio, 2021; Pradhan, Arvin, Hall & Norman, 2017; Chang & Berdiev, 2013; Hussels, Ward & Zurbruegg, 2005).



The determinants of insurance market development that have been identified in the literature include amongst other factors: interest rates, inflation rate, government spending on social services, national income, insurance literacy, political environment, religion and regulatory/legal factors.

# INTRODUCTION cont'd

---

- Insurance market development refers to the state of the insurance market as measured by quantity, quality and efficiency. Insurance market development is usually measured by two quantitative proxies—namely ; insurance density and insurance penetration. Insurance density refers to the insurance premiums per capita whilst insurance penetration is percentage measure of insurance premiums relative to the gross domestic product. An insurance market would be considered to be well developed should these metrics be high in comparison to the global average.
- The nexus between insurance market development and economic growth has been the subject of extensive research over the years. There are four predominant schools of thought that explain the finance-growth causal relationship.
- The first hypothesis which has become known as the “supply-leading” hypothesis contends that the causal relationship is supply-leading, that is growth in the financial sector will spur economic growth.
- The second school of thought is the “demand-following” hypothesis and postulates that economic growth leads to an increase demand in financial services.
- The third school of thought is the “complementarity” hypothesis and advances the notion that economic growth and financial development are intertwined and mutually reinforce one another.
- The fourth school of thought is the “neutrality” hypothesis and it contends that there is no causal relationship between financial development and economic growth.

# Insurance Market Development and Economic Growth Nexus

---

The empirical evidence is consistent with the four schools of thought.

---

Notwithstanding, most studies have documented a positive causal relationship that runs from the insurance market development to economic growth consistent with the supply-leading hypothesis.

---

Outreville (1990) investigated the economic significance of insurance markets in 55 developing countries. He set out to investigate empirically the relationship between property-liability insurance premiums and economic and financial development. He finds evidence in support of the supply-led growth hypothesis

---

Arena (2008) examined the causal relationship between insurance market activity and economic growth by employing a panel of 55 developing and developed countries for the period between 1976 and 2004. The result of the study documented a positive causal relationship running from life and nonlife insurance to economic growth.

# Insurance Market Development and Economic Growth Nexus

---

Ćurak, Lončar and Poposki (2009) examined whether life and non-life insurance individually or collectively contribute to economic growth across a sample of 10 transition European member countries for the period 1992 to 2007. Their results indicated that insurance sector development positively and significantly promotes economic growth. The results were confirmed in terms of life, non-life insurance as well as total insurance

---

Ching, Kogid and Furuoka (2010) examined the existence of a causal relationship between the life insurance sector and economic growth in Malaysia. They established a causal relationship running from the insurance sector to the economy in Malaysia.

---

Alhassan and Biekpe (2016) examined the causal relationship between insurance development and economic growth by employing a sample of eight African countries. They found evidence in support of the supply-leading hypothesis in six of the countries.

Other authors who investigated this phenomenon and found a positive relationship include amongst others : , Han, Li, Moshirian, et al. (2010) ; Ul Din, Abu-Bakar and Regupathi (2017) and Pradhan, Arvin, Nair and Bennett (2020) .

# Information Communication Technologies and Insurance Market Development

The second premise of this paper is that technological innovations have a positive influence on insurance market development.

A growing strand of studies have interrogated the relationship between information communications technology (ICT) adoption and insurance market development.

These studies have mainly established a positive relationship between ICT adoption and insurance market development.

Refer to: Akinlo (2023); Sibindi (2022); Benlagha and Hemrit (2020) and Asongu and Odhiambo (2019).

In the same vein the application of artificial intelligence in the insurance sector has received heightened attention of scholars and practitioners in recent years.

The main issues that have been addressed by such studies include: the application of artificial intelligence in the insurance value chain as well as challenges and opportunities of adopting artificial intelligence by the insurance industry.

# Research Objectives

To establish the global trends in insurance market development.

To establish how artificial intelligence has been adopted in the insurance value chain.

To identify emerging themes on the application of artificial intelligence in the insurance sector

To establish if there are any paradigm shifts in insurance occasioned by the application of artificial intelligence.



# INSURANCE MARKET DEVELOPMENT

- In this section we consider the key metrics in insurance sector development. These are the trends in global life and non-life premiums as well as the trends in life and non-life insurance penetration.
- The leading life and non-life insurance premia writing countries are documented in Figure 1. The US was the leading country in terms of premium volumes for both life and non-life categories in 2021. For the non-life insurance category it accounted for approximately US2,1 trillion dollars. For the life insurance category it accounted for US609 billion dollars.
- What is also noteworthy is that the non-life insurance sectors in the US, Germany and Canada wrote more premia compared to the life insurance sectors in contrast to the other countries where the life insurance sectors dominates the non-life insurance sectors.
- China ranks second, Japan third, United Kingdom fourth, France fifth and Germany sixth respectively in terms of premium volumes.
- This is not surprising as this is consistent with the level of development of the countries. Highly developed countries have better developed insurance markets. India ranked tenth. This is primarily due to its population rather than the development of its insurance markets.

Figure 1: Leading life and non-life direct premium writing countries globally in 2021, by premiums

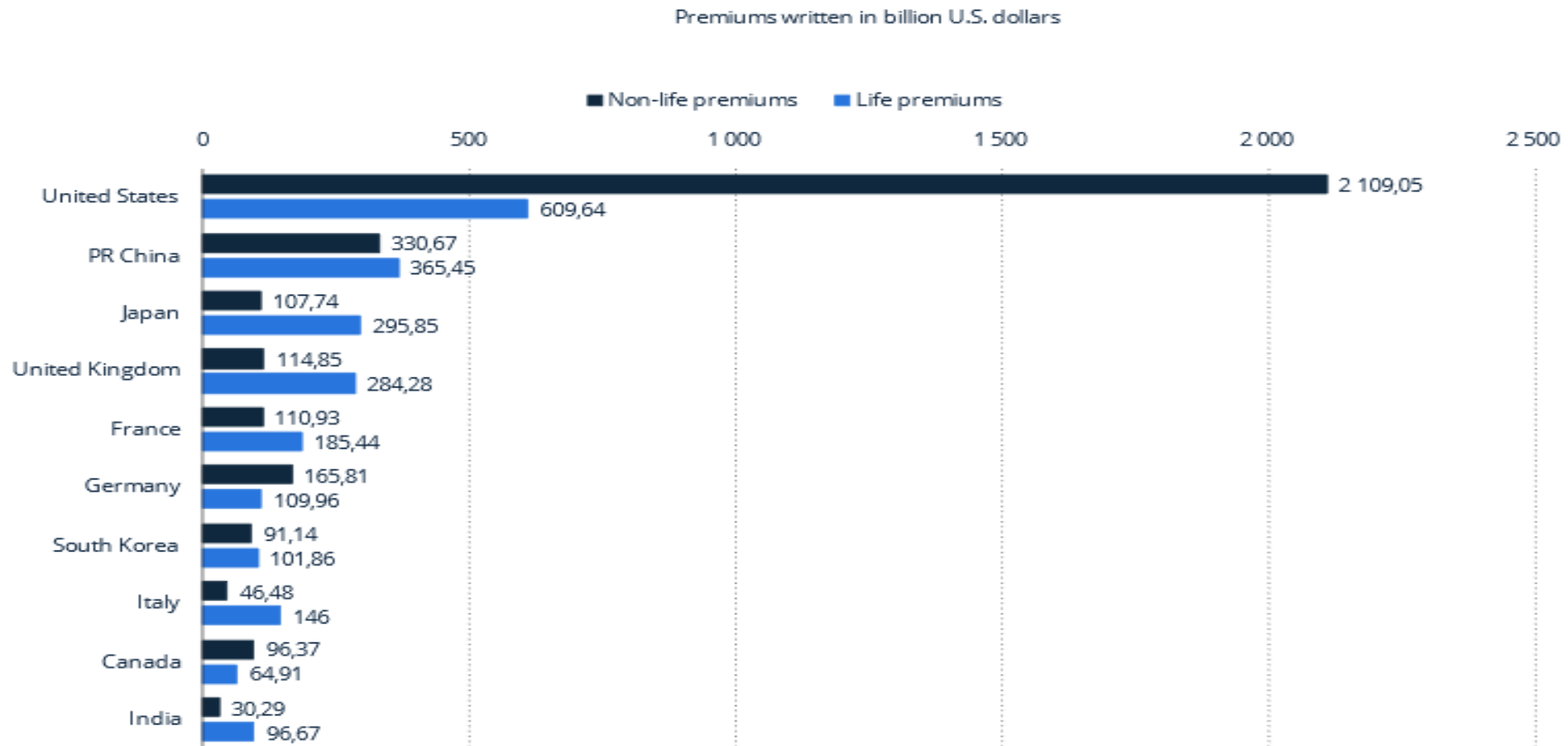


Figure 2: Market share of leading life and non-life direct premium writing territories globally in 2021

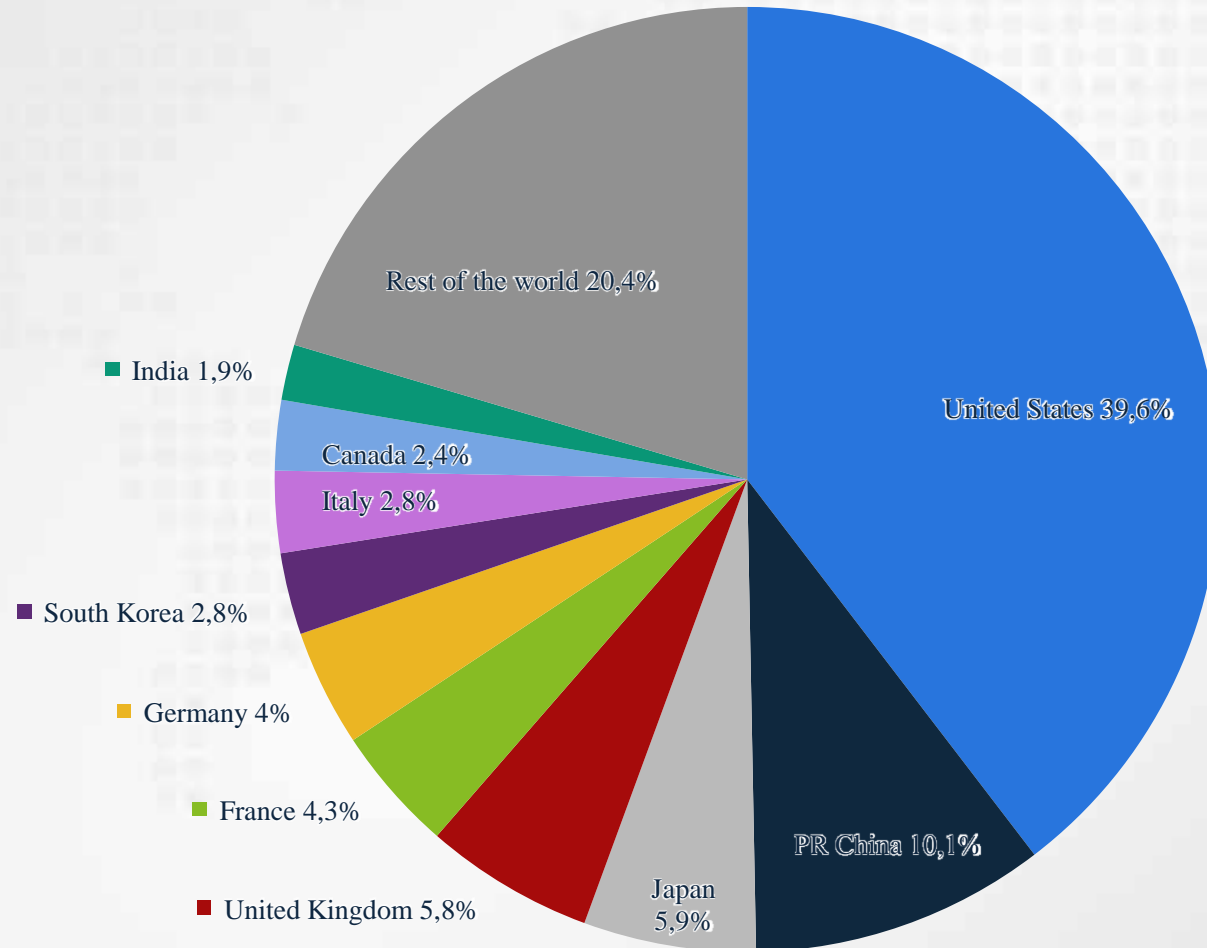


Figure 3: Value of insurance premiums worldwide from 2010 to 2020

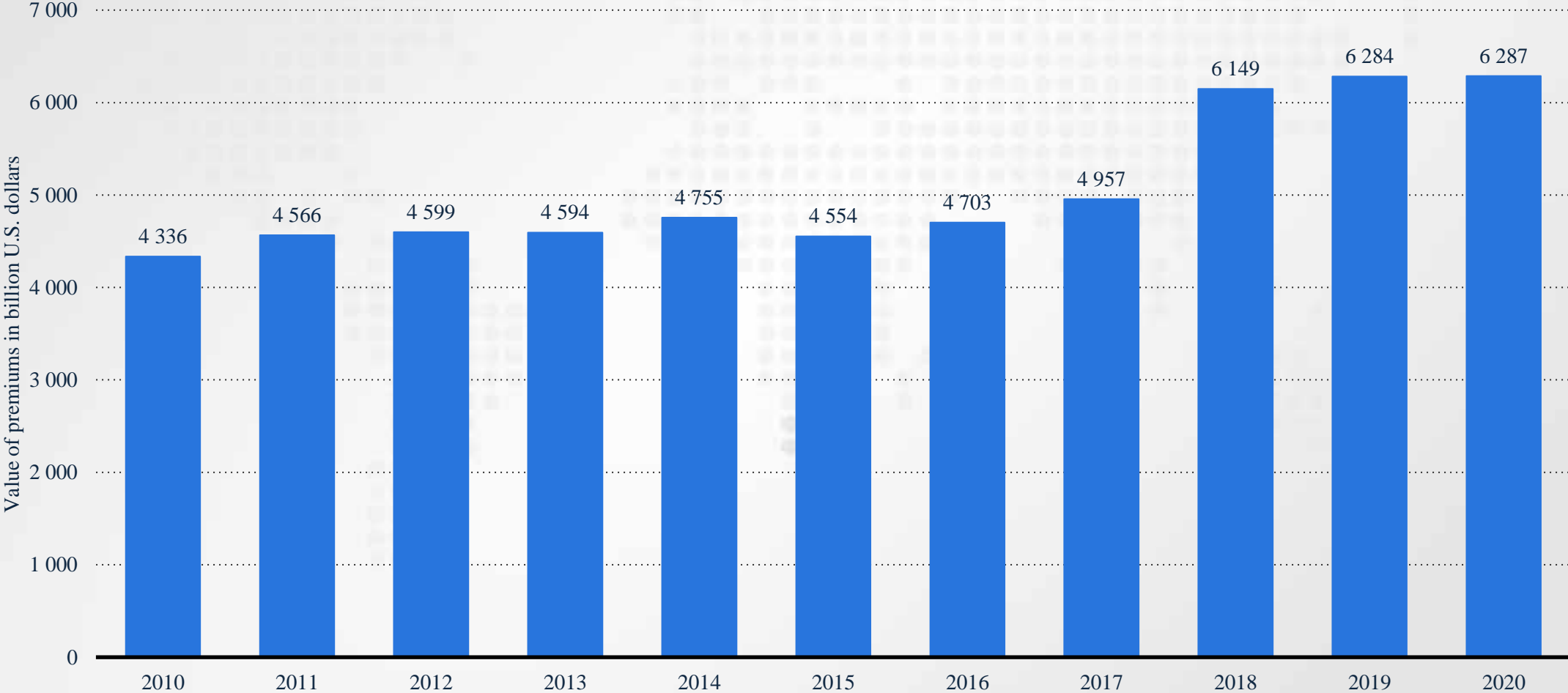
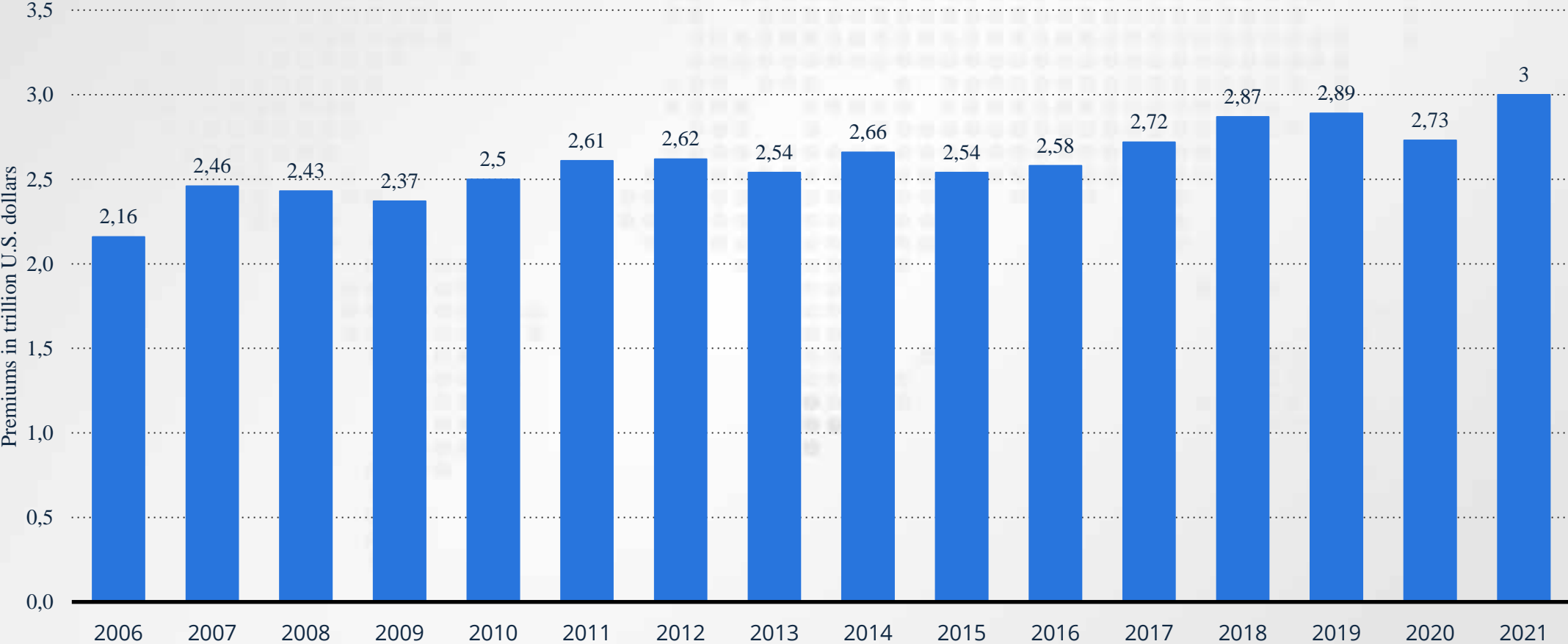


Figure 4: Total direct premiums written in the life insurance industry from 2006 to 2021



# Figure 5: Distribution of life and non-life insurance direct premiums written globally from 2006 to 2020

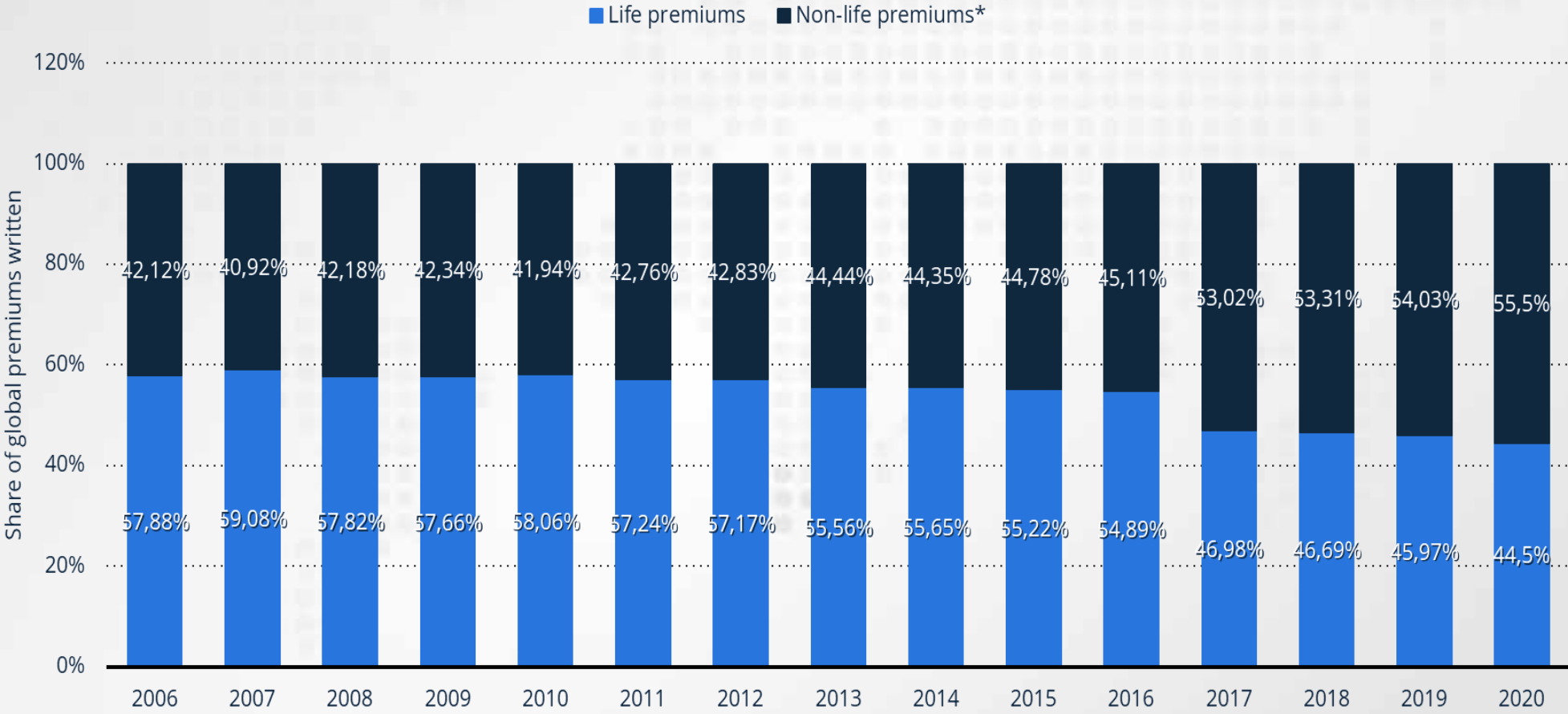
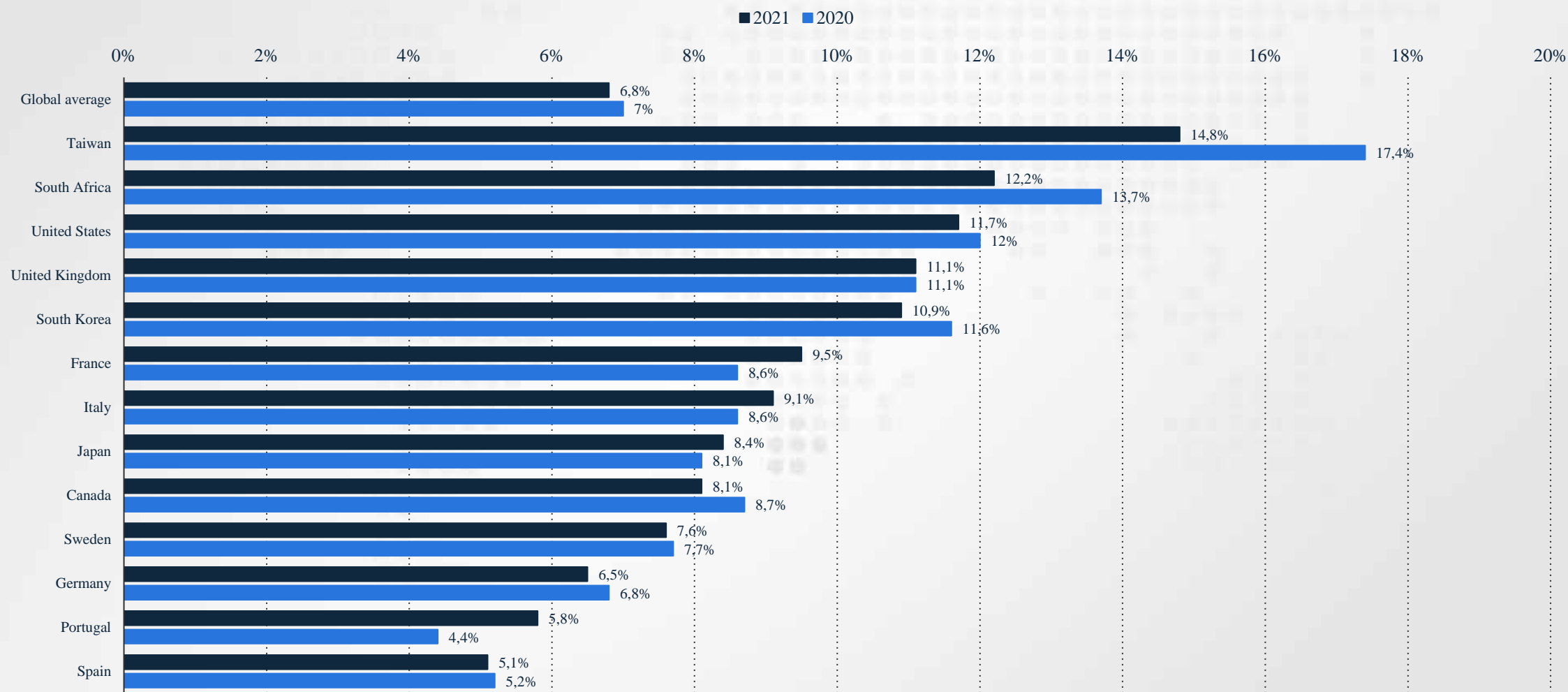
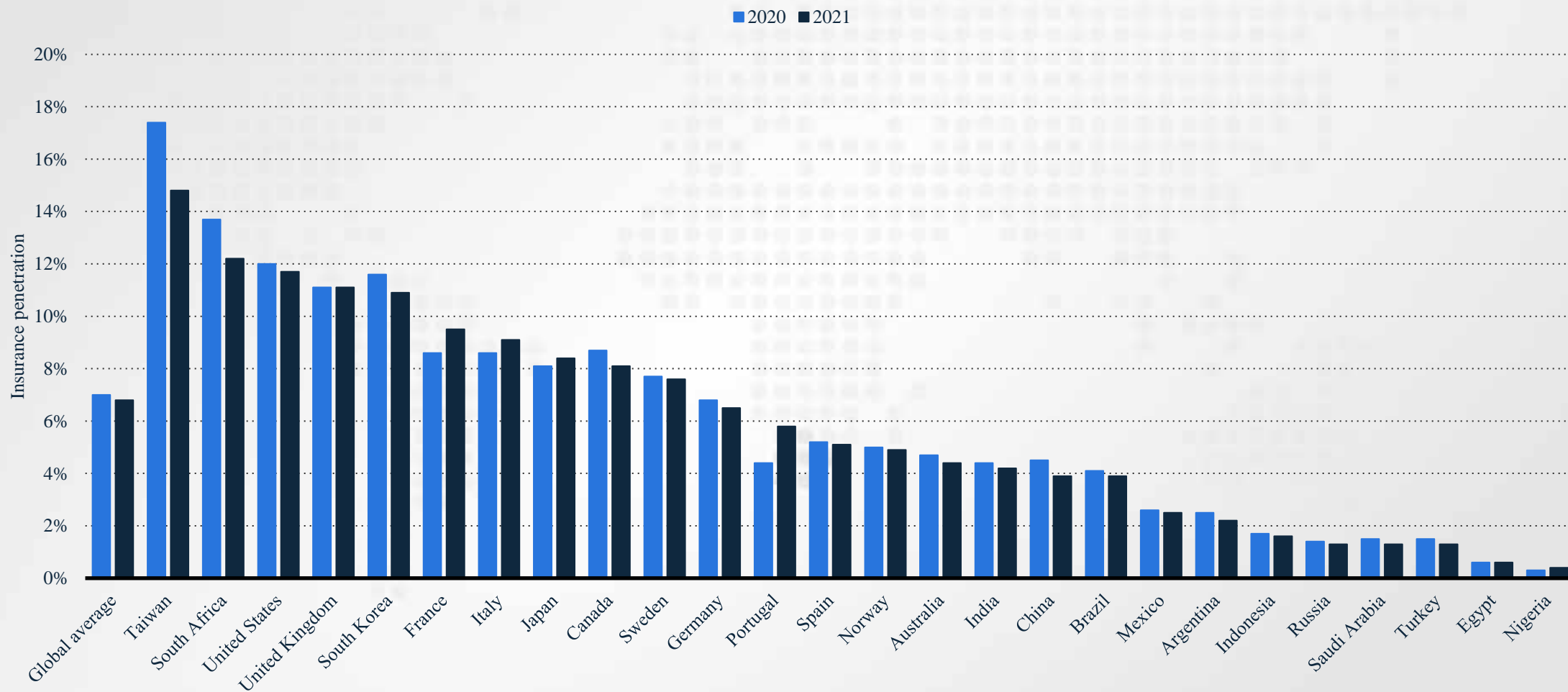


Figure 5: Distribution of life and non-life insurance direct premiums written globally from 2006 to 2020

# Figure 6a: Life and non-life insurance penetration in selected regions globally 2021

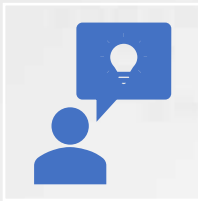


# Figure 6b: Life and non-life insurance penetration in selected regions globally 2021





# ARTIFICIAL INTELLIGENCE



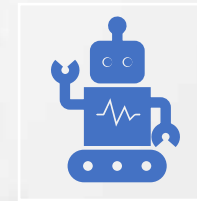
There are numerous definitions of artificial intelligence. These depend on the context and scope of the discussion.



In the context of the present inquiry, I found the definition by Statista (2023) to be more persuasive.



Artificial Intelligence (AI) essentially refers to computing technologies that are inspired by the ways people use their brains and nervous systems to reason and make decisions, but they typically operate quite differently (Statista, 2003:7).



According to Moloi and Marwala (2021:14) AI is centred on the ability of machines to imitate human intellectual behaviour.

# Artificial Intelligence Ecosystem

The artificial intelligence ecosystem currently comprises three components.

These are machine learning, robotics and artificial neural networks.

# Machine learning (ML)

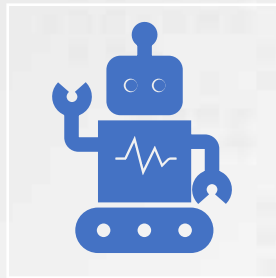
+

•

○

- According to Statista (2023) ML involves designing new learning algorithms and improving existing ones to enable computers to act without explicit programming.
- These algorithms allow computers to analyze large volumes of complex data to recognise patterns and make predictions and adjustments.
- The different types of machine learning are:(i) supervised learning (ii) unsupervised learning and (iii) reinforcement learning.

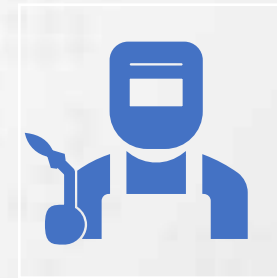
# Robotics



This branch of technology is concerned with developing and training robots to interact with people and the world in general in predictable ways (Statista, 2023).



However, current efforts also revolve around using deep learning to train robots to manipulate situations and act with a certain degree of self-awareness.



The main fields within robotics are: (i) soft robotics (ii) swarm robotics (iii) touch robotics (iv) humanoid robots and (v) Serpentine robots

# Artificial Neural Networks (ANN)



According to Statista (2023) artificial neural networks are concerned with developing algorithms that mimic the functioning of the neocortex area of the human brain, where all the thinking occurs.



There are three different types of ANNs namely: (i) deep learning, (ii) convolutional neural networks and (iii) recurrent neural networks.

# Figure 7: Artificial intelligence (AI) market size worldwide in 2021 with a forecast until 2030

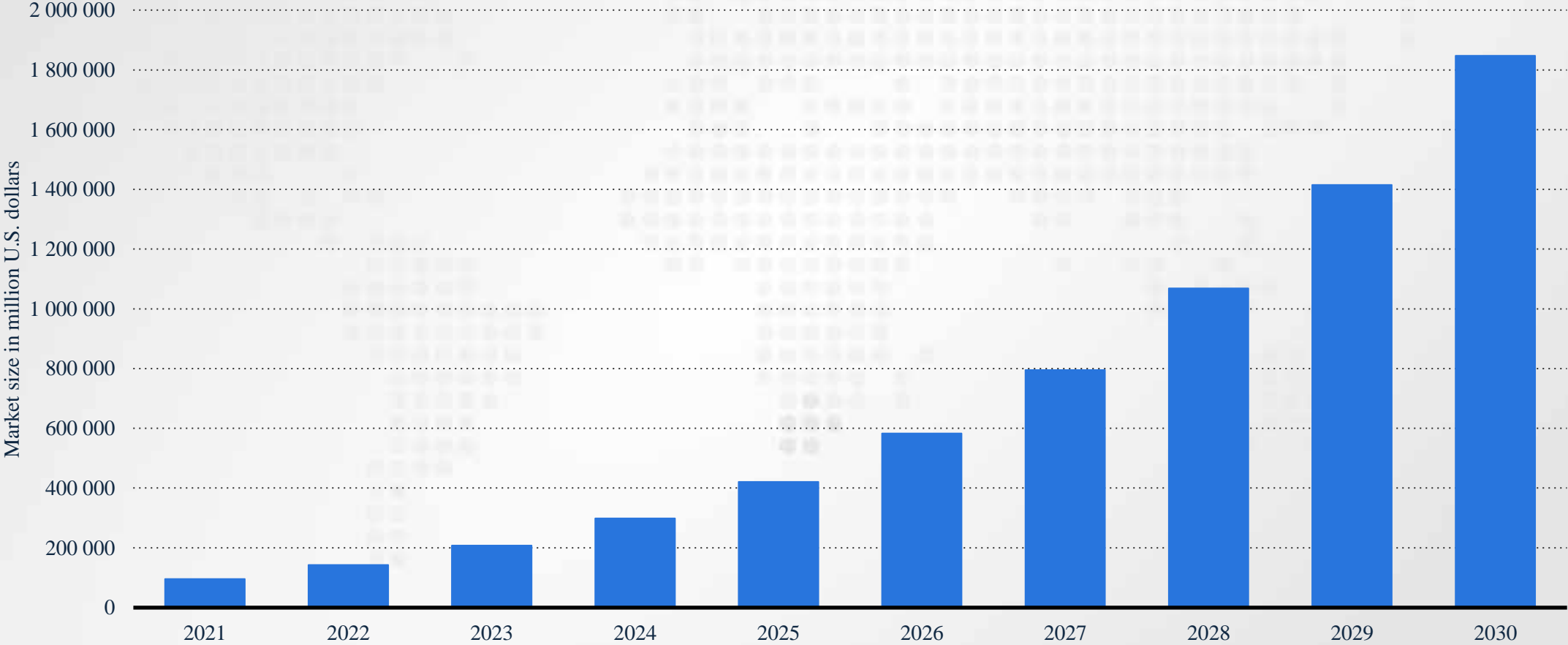
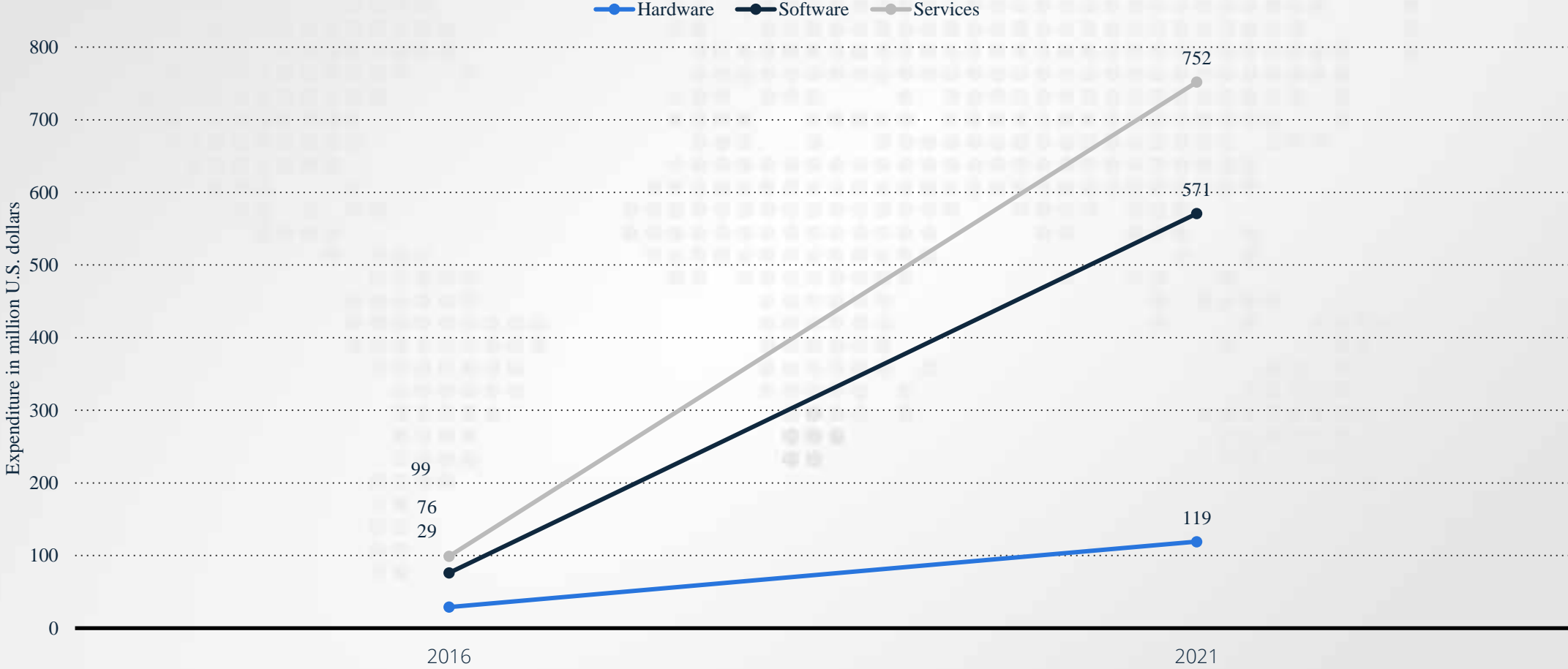
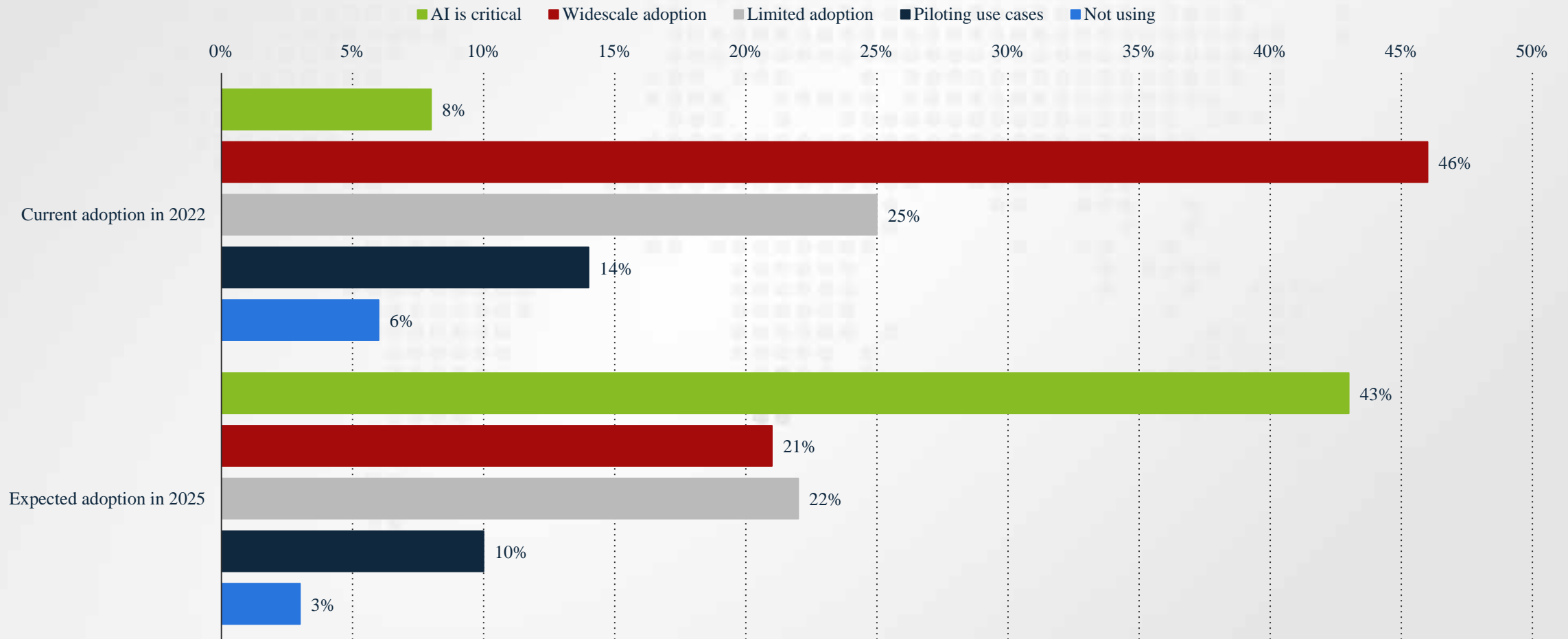


Figure 8: IT spending by insurers on cognitive/AI technologies worldwide in 2016 and 2021, by type

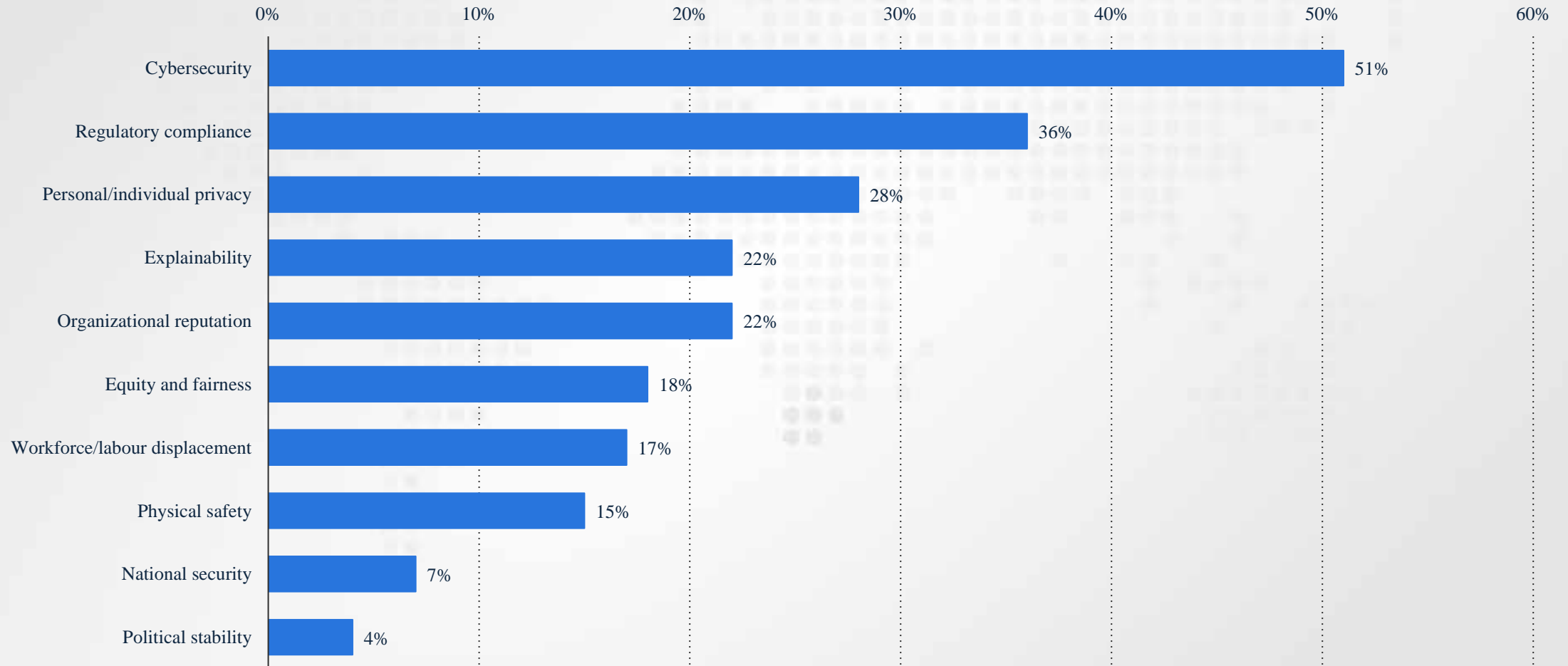


# Figure 9: Artificial intelligence (AI) adoption rate in financial businesses worldwide in 2022 and 2025

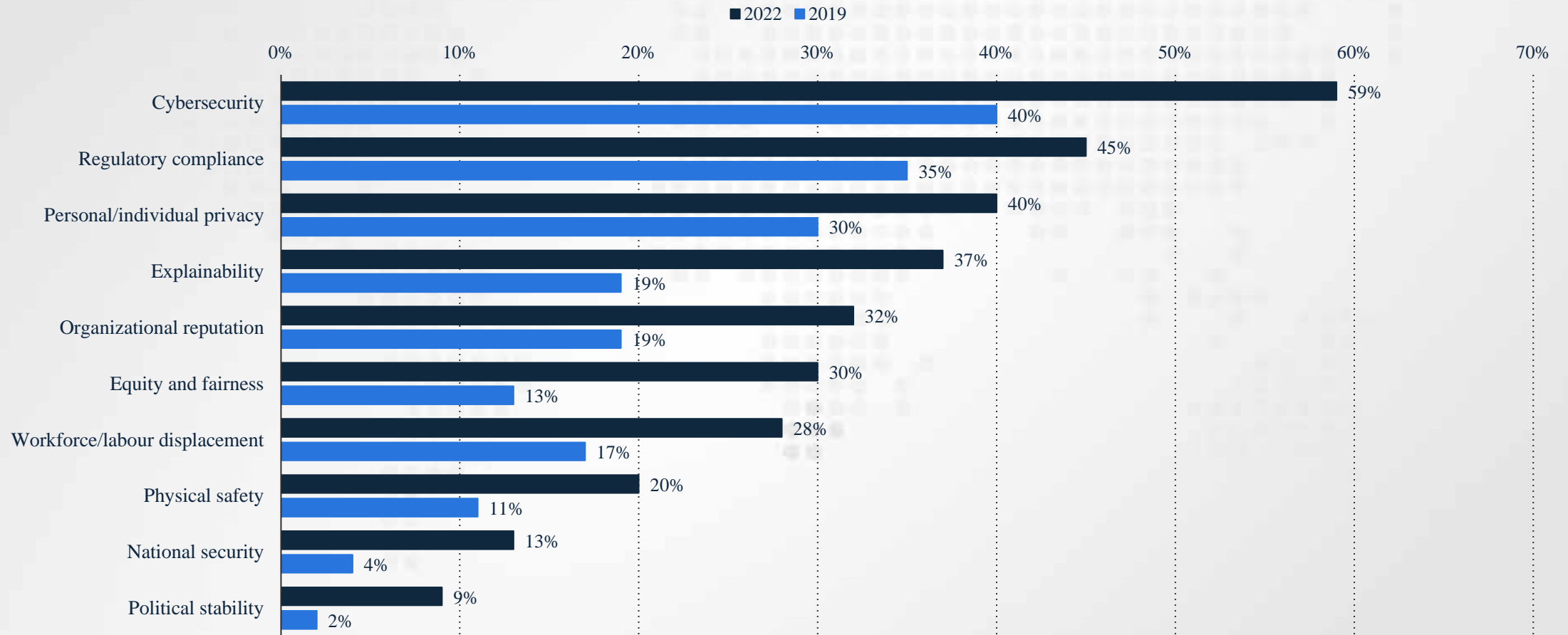




# Figure 10: Global risks being mitigated by organisations when adopting artificial intelligence in 2022



# Figure 11: Global relevance of risks when organisations adopt AI in 2019 and 2022



# APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN INSURANCE



Artificial intelligence technologies are increasingly being adopted by insurance companies and find application in actuarial, underwriting, and claims functions among other key business processes of insurance companies.



In this section we demonstrate the application of AI technologies in these functional areas with view to identifying any benefits or challenges occasioned by the assimilation of AI technologies.



For the present purpose a systematic literature review was conducted which targeted Web of Science and Scopus indexed scholarly sources.

# Artificial Intelligence and Underwriting

---

- Artificial intelligence technologies are being adopted to aid the underwriting function. Underwriting involves assessing the risk, deciding whether to accept or decline the risk, deciding on the equitable price (premium) to charge and deciding on what other terms (such as risk keeping/risk management measures) to incorporate into the policy.
- There are two main challenges faced by the underwriter in underwriting an insurance policy. They are the problems of information asymmetry and moral hazard.
- The problem of information asymmetry is common in financial contracts and arises where one party does not disclose all the pertinent information that will lead the other party to enter into an agreement or contract from an informed point of view. This would typically have a bearing on the acceptance or declination of the risk or in the alternative the price charged.



# Artificial Intelligence and Underwriting

---

- Moral hazard arises whereby the person who has taken out an insurance policy becomes disinclined to act as if they were not insured. This worsens the risk.
- To curb moral hazard the underwriter would typically include risk-keeping measures in the case of non-life insurance policies such as excesses (first amount payable) to be borne out by the insured in the event of a loss.
- With respect to life insurance policies, policy exclusions (for instance on dangerous excursions) would typically be endorsed on the policy.



# Measuring risk accurately and detecting risk



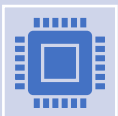
According to Maier et al. (2020) traditional underwriting limits the degree to which insurers can accurately estimate risk from data and achieve optimal price efficiency of products.



With the availability of larger historical data sets it has become possible for insurance companies to leverage on AI technologies in order to measure the mortality risk with much precision and charge equitable premiums for life insurance policies.



AI-based algorithms have proven to be the best solution to measure and to assess risk, as well as how to detect it properly (Tarkhanova et al., 2018).



This viewpoint is also buttressed by Ejiyi et al. (2022) who assert that workflows of Big Data processing techniques and AI algorithms enable underwriters to process and understand far more data than traditional processes as well as provide more accurate underwriting predictive assessments. Lastly AI technologies also helps automates and secures the process of underwriting by evaluating, for example unstructured customer data (Eckert et al., 2022).

# Risk management

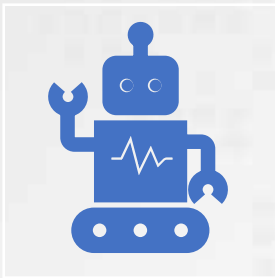


These bespoke insurance products such as pay-as/how-you-drive are becoming more prevalent in the motor insurance industry as insurers use a combination of telematics and Machine Learning (ML) methods for risk pricing (McDonnell et al., 2023).



The pay as/how-you-drive also promotes behavioural underwriting and hence the charging of an equitable premium. Moreover the monitoring of driver behaviour helps curb moral hazard.

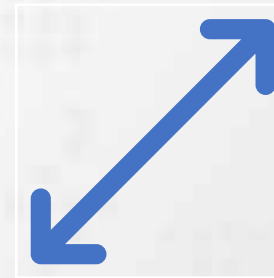
# Policy servicing



According to Ecket et al. (2022) chatbots particularly enable self-services for customers and improve service availability.



Consequently, these selected digital applications aim to improve service quality as a component of customer satisfaction.



Moreover, they have the potential to reduce costs because of increasing automation. This will ultimately translate to lower premiums.



# Artificial Intelligence and Actuarial Pricing

+

•

○

- Actuaries feature in the insurance value chain as among other roles they determine the prices (premiums) to be paid. Thus, they are involved in the pricing decisions.
- Suffice to highlight that insurance is a data driven industry. As such in the era of Big Data, actuaries are bound to thrive.
- AI technologies have been adopted by the actuarial function.
- According to Hassani et al. (2020) pioneering methods, including machine learning, predictive analytics, and deep learning techniques, are being consistently embraced throughout actuarial science.

# Artificial Intelligence and Actuarial Pricing

+

•

○

- AI technologies have been employed in the pricing of life insurance policies resulting in an improvement in the mortality risk.
- Life insurance actuaries compute the cost of covering mortality risk over the lifetime of the policy and translate it into a set of premium payments.
- More recently, rich data sets and advancements in machine learning have enabled predictive models to improve mortality-risk classification in life underwriting (Maier et al., 2020).

# Artificial Intelligence and Actuarial Pricing

+

•

○

- Artificial intelligence technologies have also been deployed in the pricing of motor insurance risks to a measured extent.
- The increasing prevalence of connected car data and advancements in Deep Learning (DL) has enhanced the ability to model driving behaviour accurately (McDonnell et al., 2023).
- The DL method's capacity to model complex, non-linear data overcomes many of the limitations of traditional pricing models.
- Further McDonnell et al. (2023) assert that, despite the increase in computational capabilities afforded by DL and the availability of highly detailed telematics data, DL is under-utilised in insurance risk pricing and accident prediction.

# Artificial Intelligence and Actuarial Pricing

+

•

○

- The pricing of emerging risks where there is scant data also poses a challenge to the actuary.
- However, AI technologies can be deployed in this regard to good effect in order to compute equitable premiums.
- Hassani et al. (2020) contend that machine learning techniques, could be a possible solution to improve policy pricing accuracy and results in the pricing of cyber security risk due to lack of data in this area and prevailing data asymmetries.

# Artificial Intelligence and Actuarial Pricing: *caveat*



+

•

○

- In the adoption of AI techniques in pricing decisions it is recommended that they be applied in conjunction with traditional statistical models to improve robustness.
- According to Rocha-Salazar and Boado-Penas (2019), a new trend is arising in which it is recommended to use both traditional statistical models and machine learning algorithms in an integral way to strengthen the result on prediction both in short and long term.
- There is evidence that machine learning may be better at making short-term predictions and statistical techniques as econometrics turn out to be better in the long term.

# Artificial Intelligence and Claims



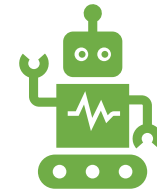
The claims function of an insurance company seeks to pay legitimate claims and reign in fraudulent claims.



It is also trite to highlight that the claims settlement processes of an insurance company is often considered to be the “window-dress” or the silent salesmen that attracts customers.



Central to this proposition is that prompt settlement of legitimate claims should be of paramount importance to the claims function of insurance companies.



AI has been harnessed by insurance companies in claims settlement.

# Artificial Intelligence and Claims

---

The application of AI technologies in claims settlement ensure the minimisation of costs and brings about efficiency in claims settlement.

---

According to Gupta et al. (2022) with the increasing number of claims and the pace of post-COVID-19 recovery, it is pertinent for the insurance sector to consider the cost-saving feature of AI applications capable of handling large amounts of data in this sector.

---

Further, Gupta et al. (2022) contend that AI applications involve ML and predictive analysis, which aim to handle large amounts of claims settlements and policy enrolment.

# Artificial Intelligence and Claims

One of the most important benefits of deploying AI technologies in claims settlement is that of curbing fraudulent claims.

To combat fraud, the insurance sector has traditionally used adjuster inspection, agent inquiry, and internal auditor examination (Aslam et al., 2022).

However, in the era of Big Data these traditional methods have become inadequate.

Thus, machine learning and artificial techniques become the most appropriate tools to mitigate fraud.

Nowadays, technology for detecting fraudulent insurance claims has been increasingly utilised in insurance and technology fields, thanks to the use of artificial intelligence (AI) methods in addition to traditional statistical detection and rule-based methods (Choi et al., 2021).



# EMERGING THEMES IN ARTIFICIAL INTELLIGENCE AND INSURANCE

## *Value creation*

- The application of AI is considered to be of strategic importance. It is a source of competitive advantage for insurance companies.
- With the diffusion of AI applications, we have seen the emergence of cyber-risk to being one of the most prominent risk.
- This should be considered to be both a challenge as well as an opportunity by the non-life insurance industry.



# EMERGING THEMES IN ARTIFICIAL INTELLIGENCE AND INSURANCE

## Privacy

- There are privacy concerns associated with the use of technologies and big data.
- Customers are usually apprehensive when it comes to sharing personal information.
- AI technology exacerbates fundamental data concerns related to privacy and surveillance because the nature of AI algorithms is such that they have an insatiable appetite for more and more data (Mullins et al., 2021).



# EMERGING THEMES IN ARTIFICIAL INTELLIGENCE AND INSURANCE

## Customer satisfaction

- With the adoption of AI by insurance companies a lot of benefits accrue to the customer.
- According to Eling et al. (2021) insureds benefit from an improved customer experience through a more personalised and efficient interaction with the insurance company; more transparent and tailored product offerings; individualised premiums in innovative insurance products; a faster purchasing process; a seamless underwriting process reduces time and effort spent by insureds; 24/7 available customer service through chatbots; more convenient claim reporting; faster claim assessment and claim payment; lower premiums due to cost reduction by the insurer



# EMERGING THEMES IN ARTIFICIAL INTELLIGENCE AND INSURANCE

## Cost-effectiveness

- Insurance companies can benefit from cost savings attributable to the implementation of AI technologies.
- According to Eling et al. (2021) insurers can profit from increased operational efficiency (cost reduction through artificial intelligence-enabled process automation mainly in underwriting and pricing as well as claim settlement, including improved fraud detection) as well as from revenue growth (artificial intelligence improving existing products and allowing the development of new, more personalised product offerings).




# TOWARDS PARADIGM SHIFTS IN INSURANCE

- The application of AI in the insurance value chain will likely occasion some paradigm shifts on how some of the fundamental insurance principles were applied.
- The use of AI has reduced the problem of asymmetry to a great extent in underwriting.
- The positive spin-offs are that this leads to a price reduction for the customer and will also ensure that persons who were previously could “insurance excluded” will now be able take-out insurance policies. Further, the traditional uninsurable risks could now become insurable.





# TOWARDS PARADIGM SHIFTS IN INSURANCE

- It is conceivable that moral hazard is being mitigated by the application of AI technologies in risk management.
  - The underwriter is in a position to both utilise dangle the “carrot” such as driving rewards in case of good driving, as well as the “stick”, that is the application of excesses in the event of accidents.
  - Moreover, the application telematics and AI in motor insurance sees a paradigm shift in insurance from “detect and repair” to “predict and prevent”. The emphasis is more on risk management.
- 

# TOWARDS PARADIGM SHIFTS IN INSURANCE



Lastly, in the era of big data, information will become easily accessible. Suffice to highlight that for instance in life insurance, underwriting comes at a cost (acquisition costs) and as such the barriers of entry are high.



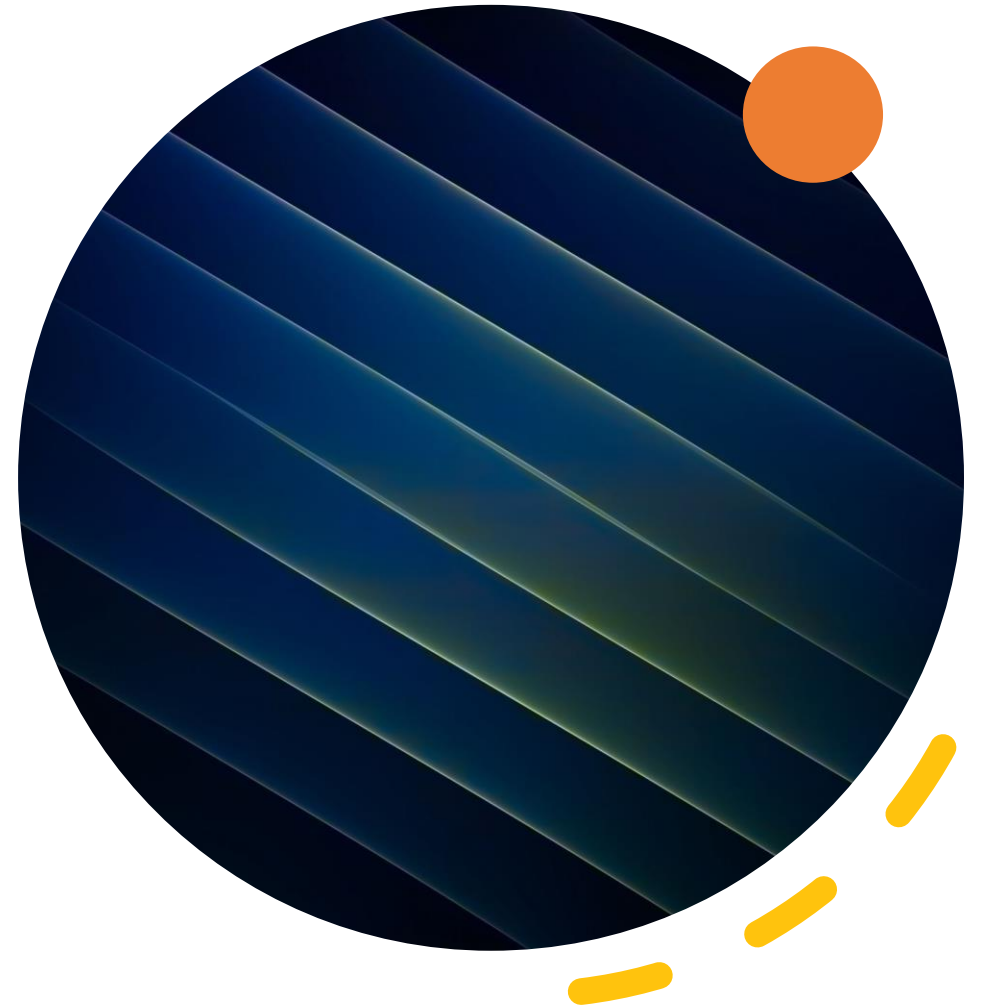
However, in the era of big data, data will likely become freely available.



This will result in smaller players coming into the fray.



We are likely to see the so-called concept of open insurance gaining momentum and disrupting the insurance sector.



# CONCLUSION

- There were four research objectives underpinning this study.
- Firstly, the study sought to establish the global trends in insurance market development. It was found that the global insurance markets in various countries were at various levels of development. They are well developed in developed countries and in the main least developed in developing countries.
- Secondly, the study sought to establish how artificial intelligence has been adopted in the insurance value chain. It was documented that AI technologies are being harnessed in the insurance value chain and find application in actuarial pricing, underwriting and claims functions. It was also documented that they have brought several benefits to insurance companies which include cost-saving, accurately pricing risk, mitigating the fraud risk and efficiency in claims settlement.





# CONCLUSION

- Thirdly, the study sought identify emerging themes on the application of artificial intelligence in the insurance sector. It was found that value creation, privacy concerns, customer satisfaction and cost-effectiveness were some of the benefits and challenges in implementing AI in insurance processes.
- Lastly, the study sought to establish if there are any paradigm shifts in insurance occasioned by the application of artificial intelligence. There were some paradigm shifts that were identified in how insurance is now being transacted in the era of AI. These relate to information asymmetry and moral hazard. These are not likely to be of paramount importance in the transaction of insurance business in future. Further, in the AI era, traditional uninsurable risks will become insurable. We are also likely to see a move towards open insurance.

# CONCLUSION



In the final analysis the disruption brought by AI to the insurance industry is likely to spur the growth of the insurance sector.



Previously insurance excluded and underinsured persons will now become fully insured as the sector becomes competitive.



More risks will become insurable.



This will foster insurance market development.





**THANK YOU!**

